MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 3, 2022/2023

TCS2241 – COMPUTATIONAL SCIENCE

(All sections / Groups)

03 OCTOBER 2023
9.00 a.m – 11.00 a.m
(2 Hours)

INSTRUCTIONS TO STUDENTS

1. This Question paper consists of 3 pages (excluding cover page) with 5 Questions.

2. Attempt **ALL** questions. All questions carry equal marks and the distribution of the marks for each question is given.

3. Please print all your answers in the Answer Booklet provided.

Question 1

Given the following Linear Programming problem, answer the following questions.

$$\begin{aligned} \text{Maximize} \quad & Z = 6x + 4y \\ \text{subject to} \quad & 4x + 2y \leq 200 \\ & 2x + 2y \leq 160 \\ & x \leq 40 \\ & y \leq 40 \\ & x, y \geq 0 \end{aligned}$$

(a) Use the graphical method to solve the above problem and show the feasible region and determine the optimal solution based on the corner points. [7 marks]

(b) Is the problem above belonging to the cases below and why?

(i) Infeasible solution [1 mark]
(ii) Unbounded solution [1 mark]
(iii) Redundant constraints [1 mark]

Question 2

(a) A plant nursery wishes to prepare a supply of a unique plant growth booster at a minimal cost by mixing two nutrients, X and Y. The mixture contains at least 45 units of phosphorus, at least 36 units of nitrogen, and at least 40 units of potassium. Nutrient X costs the nursery RM0.97 per pound, and nutrient Y costs the nursery RM1.89 per pound. Nutrient X contains 5 units of phosphorus and 2 units of nitrogen and 2 units of potassium. Nutrient Y contains 3 units of phosphorus and 3 units of nitrogen and 5 units of potassium. How many pounds of each fertilizer should the nursery use in order to minimize the cost? Construct the decision variables, objective function, and all constraints for this problem. [3.5 marks]

(b) Given the following Linear Programming problem, use the simplex method to find the optimal solution.

$$\begin{aligned} \text{Maximize} \quad & P = 5x + 2y + z \\ \text{Subject to} \quad & 2x + y + z \leq 6 \\ & 3x + 4y + 2z \leq 10 \\ & x, y, z \geq 0 \end{aligned}$$

[6.5 marks]

Continued...

Question 3

A company needs to transport goods from four suppliers (S1, S2, S3, and S4) to three warehouses (W1, W2, and W3) efficiently. The shipping costs (in RM per unit) from each supplier to each warehouse are given in the following table:

	S1	S2	S3	S4	Supply
W1	12	15	7	13	80
W2	10	14	9	16	120
W3	8	11	6	18	130
Demand	100	150	120	80	

(a) Use Northwest-Corner Rule to find the initial basic feasible solution.

[5 marks]

(b) Compute the **FIRST** round of optimality test based on the result from (a) and determine the **FIRST** entering and leaving variable.

[5 marks]

Question 4

(a) Harmony Builders & Developers SDN BHD is constructing a residential building. The involved activities and durations (in days) are provided in the following table:

Activity	Description	Predecessor(s)	Duration (days)
A	Obtaining building permits	-	7
B	Clear the construction site	A	5
C	Lay foundation	B	10
D	Build walls	C	15
E	Install roof	D	7
F	Install windows and doors	D	10
G	Electrical wiring and plumbing installation	E,F	8
H	Interior finishing	G	12
I	Exterior landscaping	H	6

(i) Illustrate the project network diagram. [1 mark]
(ii) Compute the earliest and latest event times for each of the activities. [2 marks]
(iii) Discover the critical path and compute the total project time. [2 marks]

Continued...

(b) You have a transportation network connecting several cities with highways. Each highway has a specific travel time as presented in the table below.

	1	2	3	4
1	-	5	8	∞
2	∞	-	3	∞
3	∞	∞	-	2
4	∞	∞	∞	-

(i) Construct the network graph based on the table above. [1 mark]

(ii) Using Floyd's algorithm to compute the shortest travel time between the cities. [4 marks]

Question 5

(a) A retail store wants to optimize its inventory management for a particular product. The store experiences a steady demand rate for the product. The store sells 8,000 units of the product every year. Placing an order incurs a fixed cost of RM200 per order. In every year, the retail store needs to pay RM5 per unit of the product that stored in the inventory.

(i) Compute the optimum order quantity (EOQ). [1 mark]

(ii) Compute the total annual cost (TCU). [1 mark]

(b) Determine whether the given function is convex or concave.

$$-2x^2 - x + 3$$

[3 marks]

(c) Using the Lagrangian method to solve the given non-linear programming problem:

Minimize $Z = a^2 + 2b^2 + 3c^2 + 4a + 2b + 5c + 10$

Subject to $a + b + 2c = 15$

$a, b, c \geq 0$

[5 marks]

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